UNBOXING SMARTPHONE INSIGHTS: DATA DIVE WITH SQL AND POWER BI

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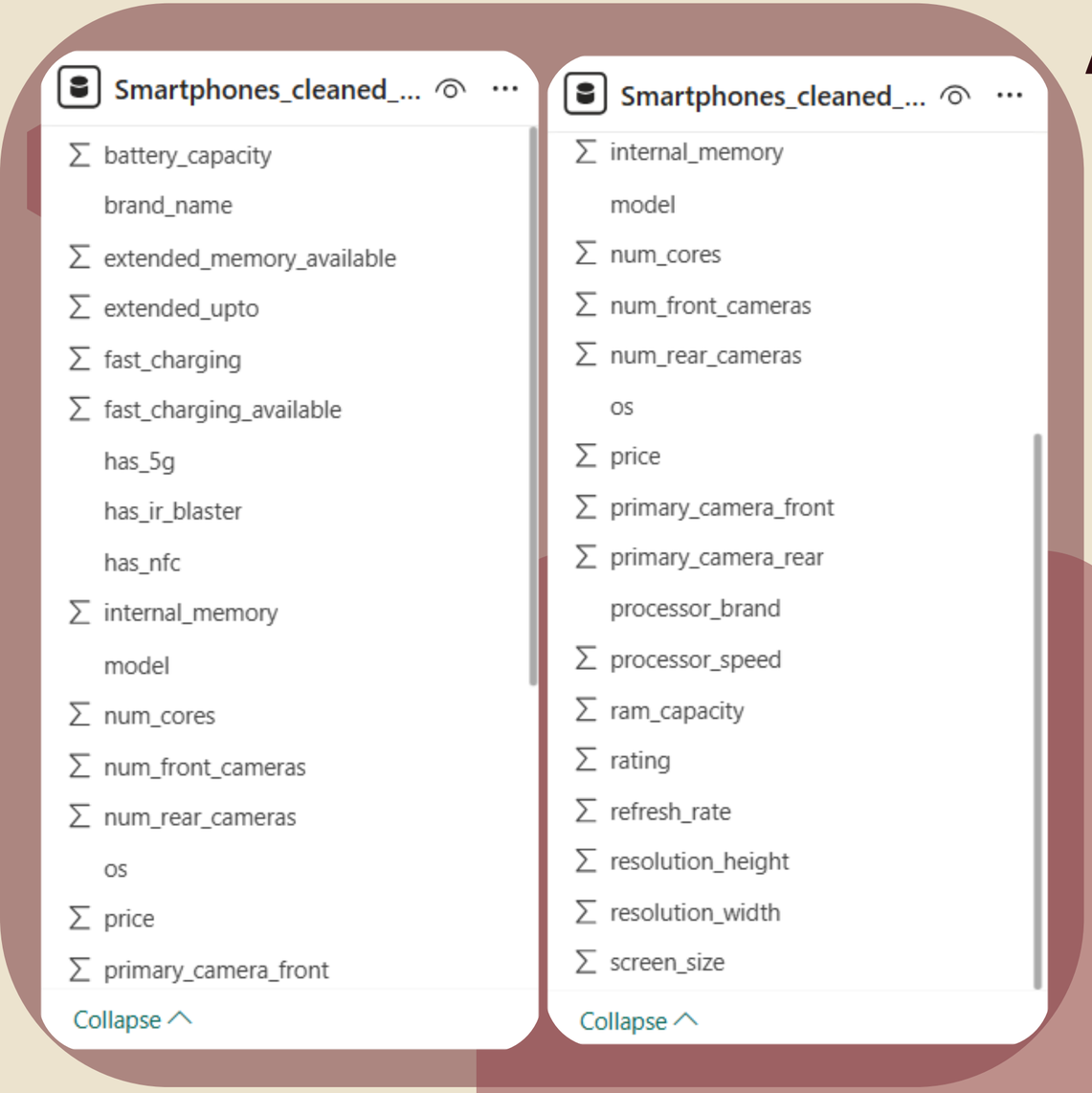
INTRODUCTION

This project aims to analyze smartphone data to uncover insights into pricing trends, feature importance, and consumer preferences in the rapidly evolving tech market. By examining key specifications such as processor performance, camera quality, battery capacity, and connectivity options, we seek to understand how these factors influence smartphone prices and user ratings.

The analysis is highly relevant given the fast-paced advancements in smartphone technology and the growing demand for budget-friendly yet feature-rich devices. Understanding price-feature relationships helps consumers make informed choices while enabling manufacturers to optimize product offerings. Additionally, this study can support recommendation systems, price prediction models, and trend analysis to stay ahead in the competitive smartphone industry.



ABOUT THE DATASET

This dataset is sourced from Kaggle and contains cleaned and preprocessed smartphone specifications, ensuring high-quality analysis-ready data. It comprises 26 columns with detailed records covering key aspects such as:

- Pricing & Ratings: Price (INR), User Ratings
- Hardware & Performance: Processor (Brand, Speed, Cores), RAM, Storage (Internal & Expandable)
- Battery & Display: Capacity (mAh), Fast Charging, Screen Size, Refresh Rate, Resolution
- Camera & Connectivity: Rear & Front Camera Specs, 5G, NFC, IR Blaster support
- Software: Operating System

All fields have been cleaned and preprocessed, making the dataset ideal for EDA, predictive modeling, and trend analysis in smartphone technology.

ANALYTICAL SECTIONS BY CATEGORY

Price & Ratings – SQL Queries

What is the average price of smartphones by processor brand?

```sql
SELECT
    processor_brand, AVG(price) as price
FROM
    smartphones_cleaned_dataset
GROUP BY processor_brand
order by price desc;
```

Result Grid | Filter Rows:

processor_brand	price
bionic	90908.5238
google	49293.3333
kirin	44309.6667
snapdragon	33910.3371
exynos	32645.0714
dimensity	25323.6474
helio	12710.2926
	10635.5000
tiger	9715.0500
unisoc	9115.1176
sc9863a	7124.0000

Which brands offer smartphones under ₹15,000 with 5G support?

```sql
SELECT
    brand_name, price, has_5g
FROM
    smartphones_cleaned_dataset
WHERE
    price < 15000 AND has_5g = 'True';
```

Result Grid | Filter Rows:

brand_name	price	has_5g
motorola	14999	TRUE
poco	14999	TRUE
jio	11990	TRUE
realme	14965	TRUE
poco	14999	TRUE
iqoo	13989	TRUE
xiaomi	13999	TRUE

Which smartphones have the top 10 highest user ratings?

```sql
SELECT
    model, rating
FROM
    smartphones_cleaned_dataset
ORDER BY rating DESC
LIMIT 10;
```

Result Grid | Filter Rows:

model	rating
OnePlus 11 5G	89
OnePlus 10 Pro 5G	89
Samsung Galaxy S20 5G	89
Sony Xperia 5 IV 5G	89
Samsung Galaxy A53 5G (8GB RAM + 128GB)	89
Realme GT 2 Pro 5G (12GB RAM + 256GB)	89
Xiaomi 12T Pro 5G	89
Motorola Edge Plus	89
Google Pixel 6 Pro	89
Sony Xperia 1 II	89

Price & Ratings – SQL Queries

How does average price vary by RAM size (e.g., 4GB, 6GB, 8GB)?

```sql
SELECT
    ram_capacity, AVG(price)
FROM
    smartphones_cleaned_dataset
GROUP BY ram_capacity
ORDER BY ram_capacity;
```

Result Grid | Filter Rows

ram_capacity	AVG(price)
2	61135.2500
3	9940.0222
4	14601.5850
6	24084.4326
8	34709.1283
12	52677.8667
16	54712.0000
18	82994.5000

What is the average user rating per screen refresh rate (e.g., 60Hz, 90Hz, 120Hz)?

```sql
SELECT
    refresh_rate, AVG(rating)
FROM
    smartphones_cleaned_dataset
GROUP BY refresh_rate;
```

Result Grid | Filter Rows

refresh_rate	AVG(rating)
120	83.6022
90	77.9812
60	73.1376
144	84.9688
165	87.2857
240	89.0000

Get min, max, and average price grouped by internal storage variants.

```sql
SELECT
    internal_memory,
    MIN(price), MAX(price), AVG(price)
FROM
    smartphones_cleaned_dataset
GROUP BY internal_memory;
```

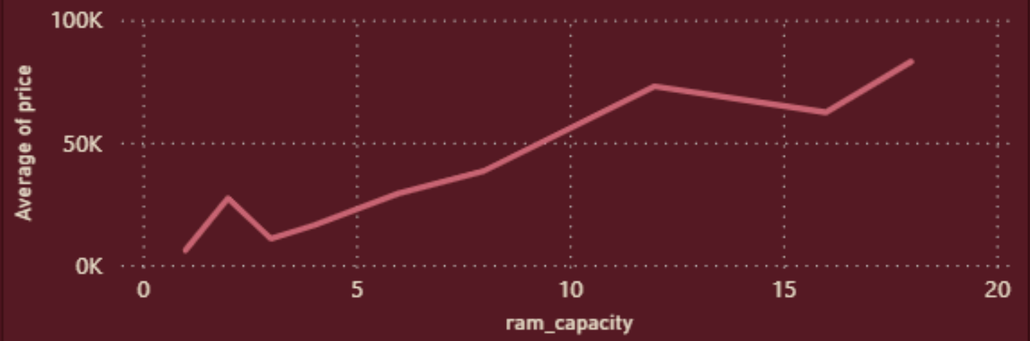
ult Grid | Filter Rows: | Export:

internal_memory	MIN(price)	MAX(price)	AVG(price)
256	15999	480000	51324.9912
128	7499	149999	25566.0620
64	5999	650000	16439.7111
32	3499	18000	8392.8810
512	39990	239999	110746.7500
1024	147900	179900	163900.0000

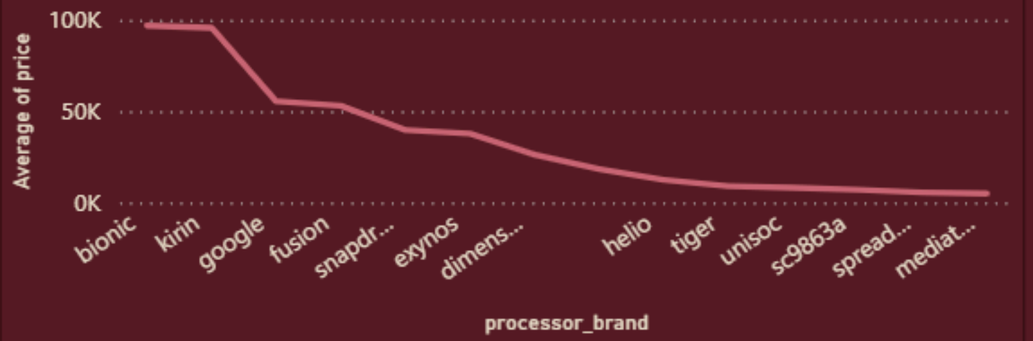
Price & Ratings Insights

- Price & Ratings Insights
- Feature-Specific Analysis
- Battery, Charging, and Performance
- Camera Analysis
- Display Trends

Average price by ram_capacity

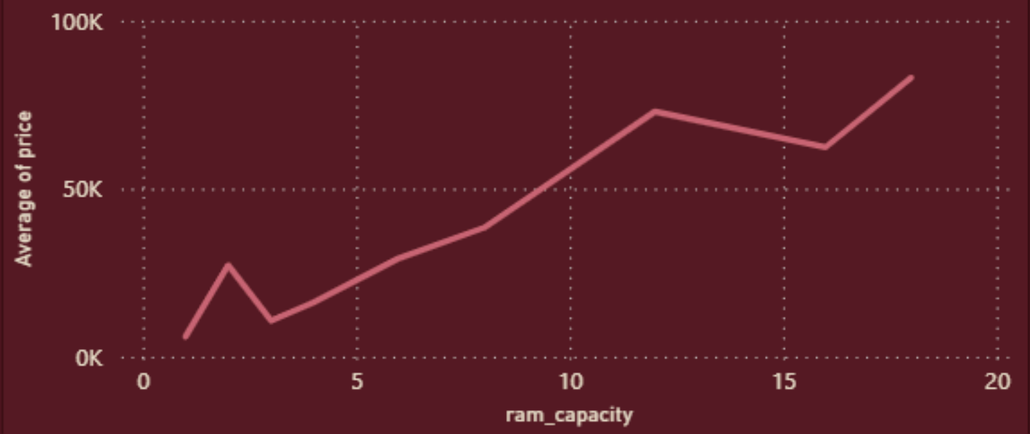


Average price by processor_brand

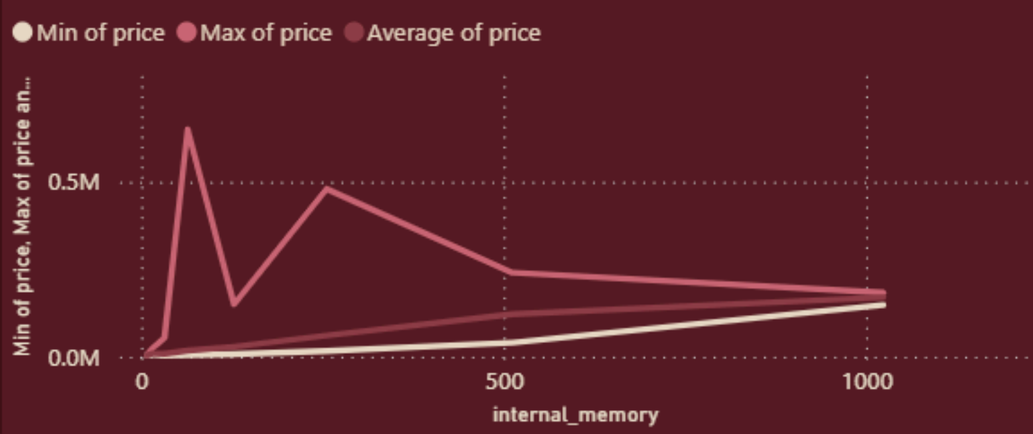


Min of price by brand_name

Average price by RAM size



Min price, Max price and Average price by internal_memory



ANALYTICAL SECTIONS BY CATEGORY

Feature-Specific Analysis – SQL Queries

How many smartphones support 5G, NFC, and IR Blaster separately or together?

```sql
SELECT
    -- Individual Features
    SUM(has_5g = "True") "5G_phones",
    SUM(has_nfc = "True") "NFC_phones",
    SUM(has_ir_blaster = "True") "IR_Blaster_phones",

    -- Pairwise Combinations
    SUM(has_5g = "True" AND has_nfc = "True")  "5G+NFC_phones",
    SUM(has_5g = "True" AND has_ir_blaster = "True") "5G+IR_phones",
    SUM(has_nfc = "True" AND has_ir_blaster = "True") "NFC+IR_phones",

    -- All Three Together
    SUM(has_5g = "True" AND has_nfc = "True" AND has_ir_blaster = "True") "5G+NFC+IR_phones"
FROM smartphones_cleaned_dataset;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

5G_phones	NFC_phones	IR_Blaster_phones	5G+NFC_phones	5G+IR_phones	NFC+IR_phones	5G+NFC+IR_phones
451	298	145	247	96	44	41

List smartphones that support both 5G and fast charging.

```sql
SELECT
    model, has_5g, fast_charging_available
FROM
    smartphones_cleaned_dataset
WHERE
    has_5g = 'True'
        AND fast_charging_available = 1;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Conte

model	has_5g	fast_charging_available
OnePlus 11 5G	TRUE	1
OnePlus Nord CE 2 Lite 5G	TRUE	1
Samsung Galaxy A14 5G	TRUE	1
Motorola Moto G62 5G	TRUE	1
Realme 10 Pro Plus	TRUE	1
Samsung Galaxy F23 5G (6GB RAM + 128GB)	TRUE	1
Apple iPhone 14	TRUE	1

Feature-Specific Analysis – SQL Queries

What is the distribution of processor core count across smartphone models?

```sql
SELECT
    processor_brand, num_cores, COUNT(model) 'number_of_phones'
FROM
    smartphones_cleaned_dataset
GROUP BY num_cores , processor_brand;
```

Result Grid | Filter Rows:

processor_brand	num_cores	number_of_phones
snapdragon	8	353
exynos	8	42
dimensity	8	173
bionic	6	21
helio	8	183
unisoc	8	17
tiger	8	18
helio	4	5

What is the most common processor brand in phones priced below ₹20,000?

```sql
SELECT
    processor_brand, COUNT(brand_name) AS number_of_phones
FROM
    smartphones_cleaned_dataset
WHERE
    price < 20000
GROUP BY processor_brand
ORDER BY number_of_phones DESC
LIMIT 5;
```

Result Grid | Filter Rows:

processor_brand	number_of_phones
helio	180
snapdragon	141
dimensity	74
tiger	20
exynos	19

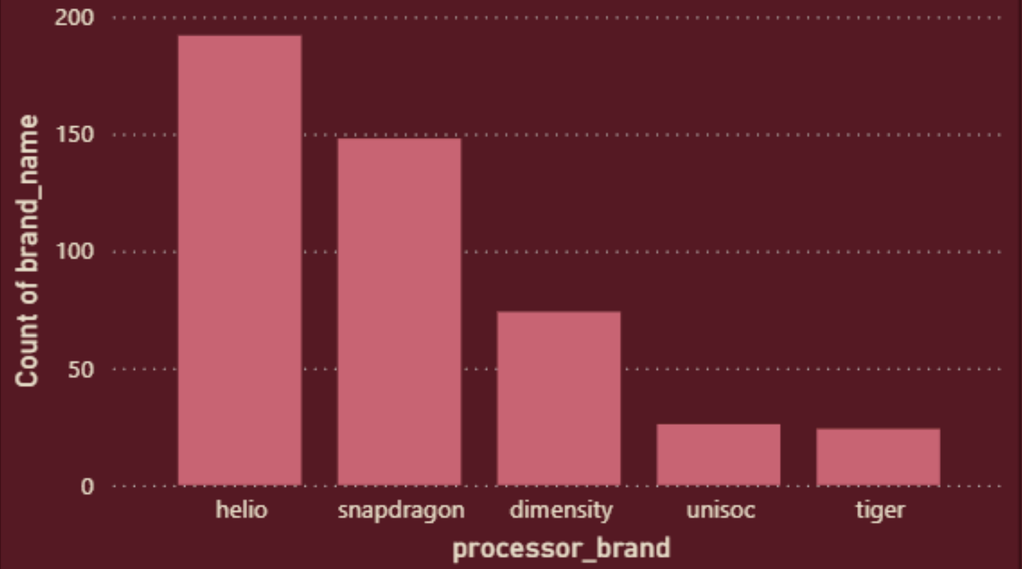
Feature-Specific Analysis

- Price & Ratings Insights
- Feature-Specific Analysis
- Battery, Charging, and Performance
- Camera Analysis
- Display Trends

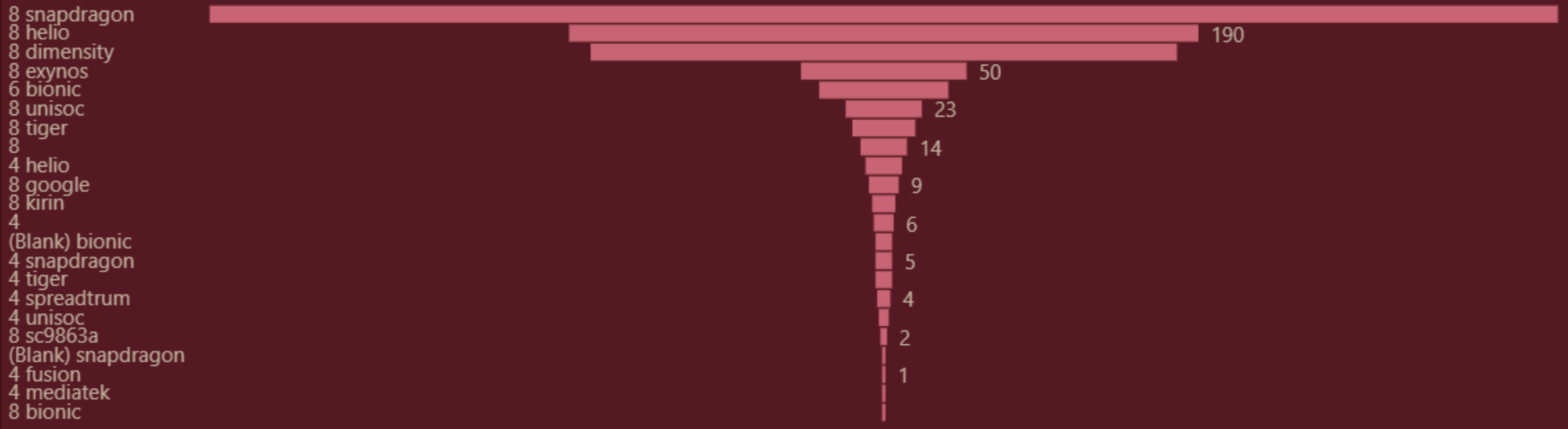
Smartphones that support both 5G and fast charging

model	price	has_5g	fast_charging
Apple iPhone 13	62999	True	1
Apple iPhone 13 (256GB)	72999	True	1
Apple iPhone 13 (512GB)	91999	True	1
Apple iPhone 13 Mini	64900	True	1
Apple iPhone 13 Pro	119900	True	1
Apple iPhone 13 Pro (1TB)	147900	True	1
Apple iPhone 13 Pro (256GB)	129900	True	1
Apple iPhone 13 Pro Max	129900	True	1
Apple iPhone 13 Pro Max (1TB)	179900	True	1
Total			**530**

Top 5 processor brand in phones priced below ₹20,000



Distribution of processor core count across smartphone models



ANALYTICAL SECTIONS BY CATEGORY

Battery, Charging, and Performance – SQL Queries

Which smartphones have the highest battery capacity in each price segment (e.g., < ₹10k, 10k-20k, >₹20k)?

```sql
WITH ranked_phones AS (
  SELECT
    model,
    battery_capacity,
    price,
    CASE
      WHEN price < 10000 THEN 'Budget (< ₹10K)'
      WHEN price BETWEEN 10000 AND 20000 THEN 'Mid-Range (₹10K-20K)'
      ELSE 'Premium (> ₹20K)'
    END AS price_segment,
    RANK() OVER (
      PARTITION BY
        CASE
          WHEN price < 10000 THEN 'Budget (< ₹10K)'
          WHEN price BETWEEN 10000 AND 20000 THEN 'Mid-Range (₹10K-20K)'
          ELSE 'Premium (> ₹20K)'
        END
      ORDER BY battery_capacity DESC, price ASC  -- Tie-breaker: cheaper first
    ) AS battery_rank
  FROM smartphones_cleaned_dataset
)
SELECT * FROM ranked_phones WHERE battery_rank = 1;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

model	battery_capacity	price	price_segment	battery_rank
Tecno Pova 3	7000	9999	Budget (< ₹10K)	1
Tecno Pova 2	7000	10999	Mid-Range (₹10K-20K)	1
Doogee V Max	22000	45999	Premium (> ₹20K)	1

Battery, Charging, and Performance – SQL Queries

Average battery capacity grouped by processor brand or number of processor cores.

```sql
SELECT
    processor_brand,num_cores,
    ROUND(AVG(battery_capacity), 0) AS avg_battery_capacity_mAh,
    COUNT(*) AS number_of_phones
FROM smartphones_cleaned_dataset
GROUP BY processor_brand, num_cores
ORDER BY avg_battery_capacity_mAh DESC;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

processor_brand	num_cores	avg_battery_capacity_mAh	number_of_phones
helio	8	5100	183
tiger	8	5056	18
unisoc	8	5012	17
helio	4	5000	5

List smartphones with both fast charging and more than 5000mAh battery capacity.

```sql
SELECT
    model, fast_charging_available, battery_capacity
FROM
    smartphones_cleaned_dataset
WHERE
    battery_capacity > 5000
        AND fast_charging_available = 1
ORDER BY battery_capacity DESC;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Con

model	fast_charging_available	battery_capacity
Doogee V Max	1	22000
Oukitel WP19	1	21000
Tecno Pova 3	1	7000
Tecno Pova 3 (6GB RAM + 128GB)	1	7000
Samsung Galaxy M62	1	7000
Samsung Galaxy F63	1	7000
Tecno Pova 2	1	7000
Samsung Galaxy M54 5G	1	6000
Samsung Galaxy M33 5G	1	6000

Battery, Charging, and Performance

- Price & Ratings Insights
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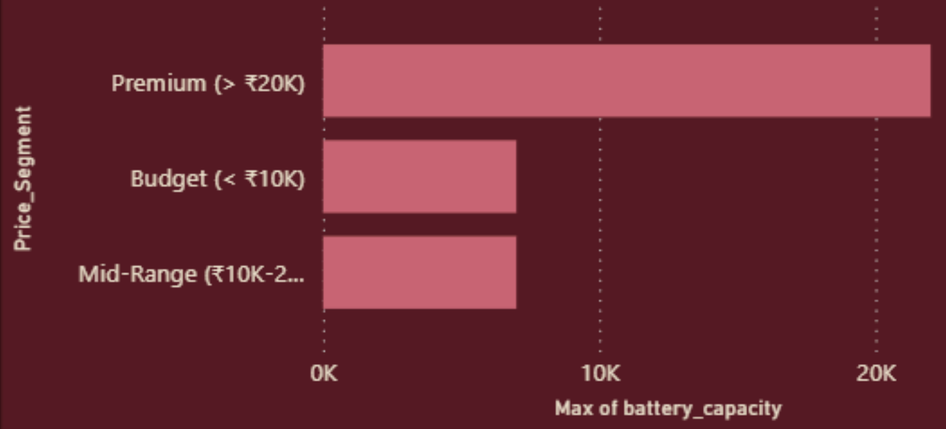
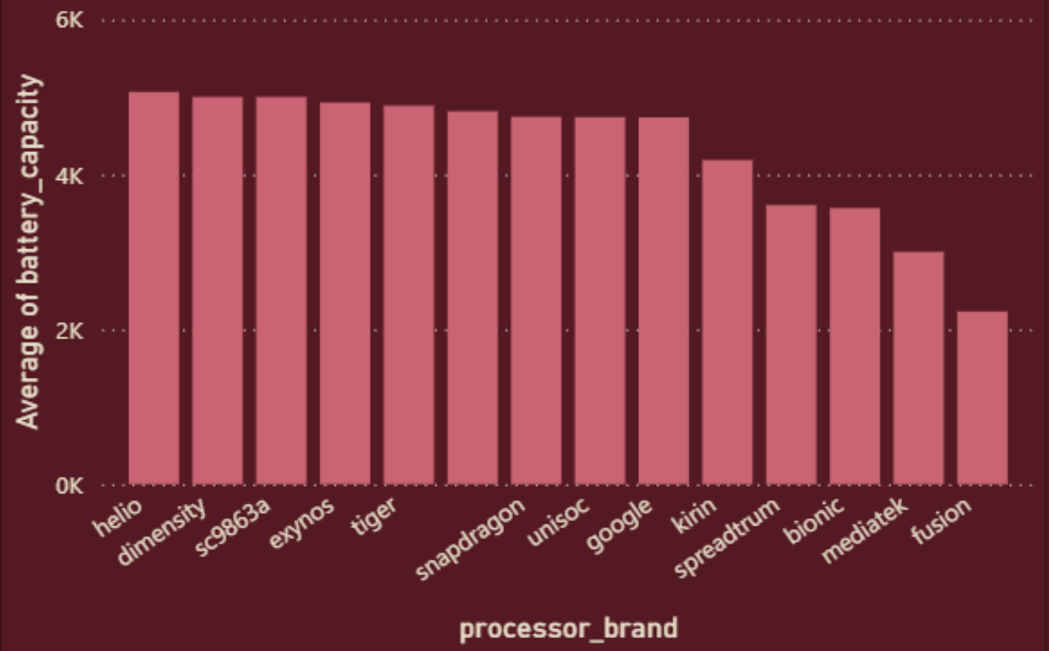
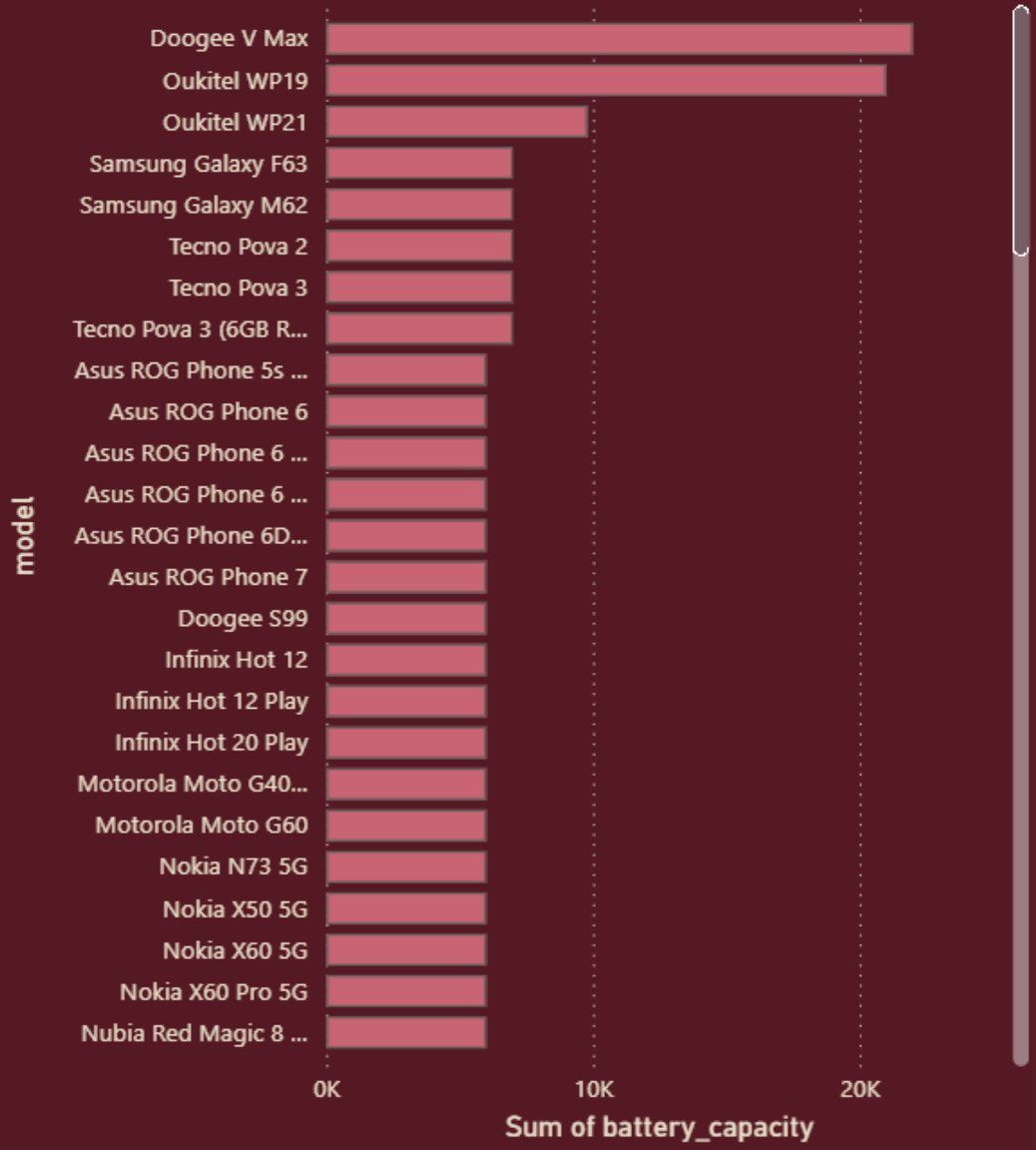
Smartphones have the highest battery capacity in each price segment



Average battery capacity grouped by processor brand



Smartphones with both fast charging and more than 5000mAh battery capacity



ANALYTICAL SECTIONS BY CATEGORY

Camera Analysis – SQL Queries

Which front cameras offer more than 32MP resolution under ₹25,000?

```sql
SELECT
  model,
  price,
  primary_camera_front
FROM smartphones_cleaned_dataset
WHERE price < 25000
AND primary_camera_front > 32;
```

model	price	primary_camera_front
Vivo V23 5G	24994	50
Vivo Y75 4G	19990	44
Infinix Zero 20	17999	60
Vivo V23e 5G	21994	44
Vivo V20	23269	44
Vivo V21	24999	44
Vivo V21 5G	23994	44
Tecno Phantom X Pro	22999	48

Average rear camera megapixels by price segments (low, mid, flagship).

```sql
SELECT
    CASE
        WHEN price < 10000 THEN 'Budget (< ₹10K)'
        WHEN price BETWEEN 10000 AND 20000 THEN 'Mid-Range (₹10K-20K)'
        ELSE 'Premium (> ₹20K)'
    END AS price_segment,
    AVG(primary_camera_rear) AS avg_rear_camera_megapixels
FROM
    smartphones_cleaned_dataset
GROUP BY CASE
    WHEN price < 10000 THEN 'Budget (< ₹10K)'
    WHEN price BETWEEN 10000 AND 20000 THEN 'Mid-Range (₹10K-20K)'
    ELSE 'Premium (> ₹20K)'
END;
```

Result Grid | Filter Rows: | Exp

price_segment	avg_rear_camera_megapixels
Premium (> ₹20K)	58.5995
Mid-Range (₹10K-20K)	50.5531
Budget (< ₹10K)	19.6857

Camera Analysis – SQL Queries

What is the maximum rear camera megapixel offered by each brand?

```sql
SELECT
    brand_name,
    MAX(primary_camera_rear) AS max_rear_camera_megapixels
FROM
    smartphones_cleaned_dataset
GROUP BY brand_name;
```

Result Grid | Filter Rows:

brand_name	max_rear_camera_megapixels
oneplus	108
samsung	108
motorola	108
realme	108
apple	12
xiaomi	200
nothing	50
oppo	108
vivo	108

List all phones where front and rear camera specs are above average.

```sql
WITH AvgCameras AS (
  SELECT
    AVG(primary_camera_front) AS avg_front_mp,
    AVG(primary_camera_rear) AS avg_rear_mp
  FROM smartphones_cleaned_dataset
)

SELECT
  brand_name,
  model,
  primary_camera_front,
  primary_camera_rear
FROM smartphones_cleaned_dataset, AvgCameras
WHERE
  primary_camera_front > AvgCameras.avg_front_mp
  AND primary_camera_rear > AvgCameras.avg_rear_mp;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

brand_name	model	primary_camera_front	primary_camera_rear
vivo	Vivo V25 Pro 5G	32	64
vivo	Vivo V26 Pro	32	64
vivo	Vivo V25 5G	50	64
vivo	Vivo V27	50	64
samsung	Samsung Galaxy M53 5G	32	108
xiaomi	Xiaomi Redmi Note 12 Pro Max 5G	32	108
oppo	OPPO Reno 9 5G	32	64
motorola	Motorola Edge 20 Fusion 5G	32	108
vivo	Vivo S16	50	64

Camera Analysis

- Price & Ratings Insights
- Feature-Specific Analysis
- Battery, Charging, and Performance
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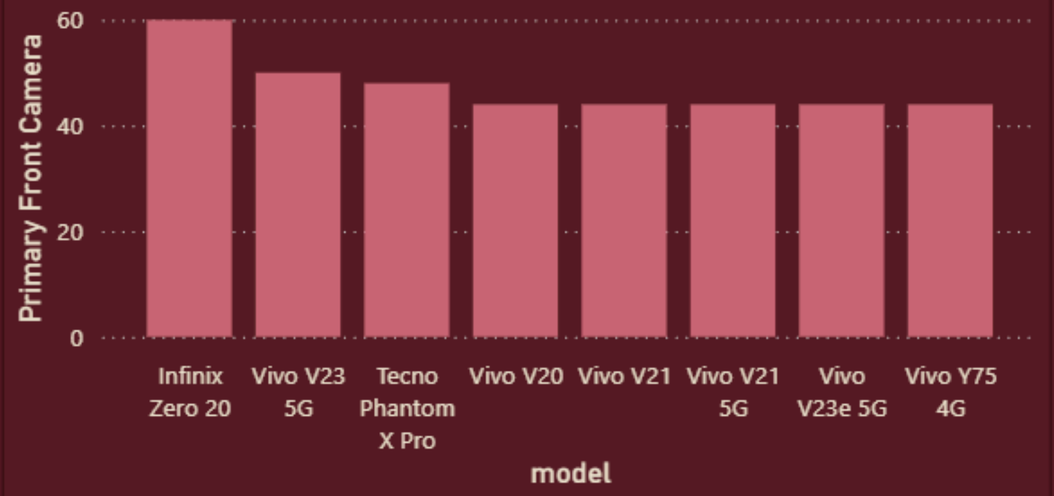
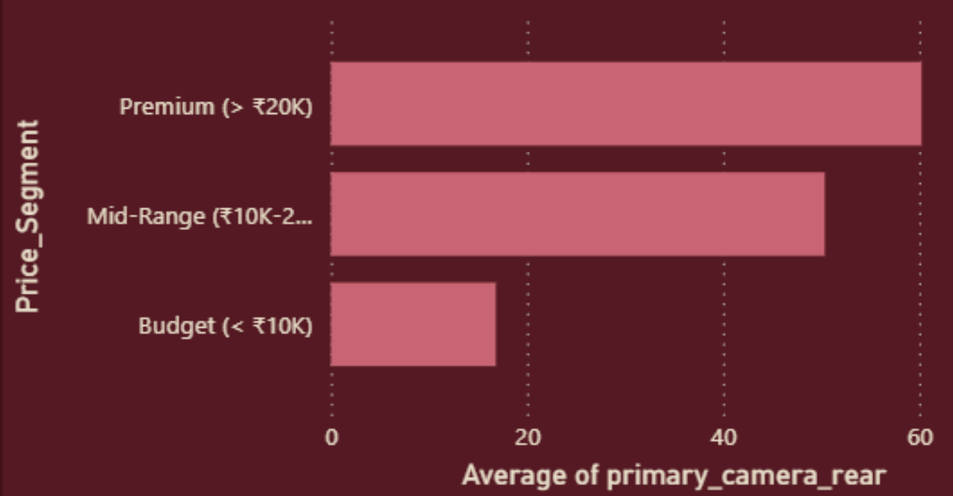
- Display Trends

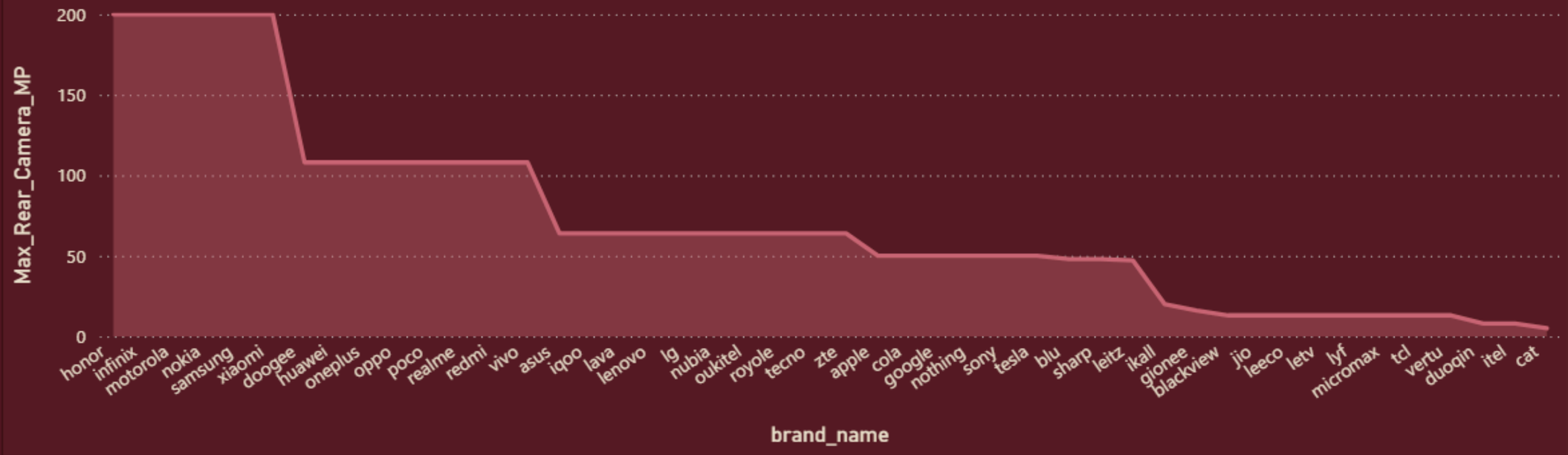
Front cameras offer more than 32MP resolution under ₹25,000



Average rear camera megapixels by price segments



Maximum rear camera megapixel offered by each brand



ANALYTICAL SECTIONS BY CATEGORY

Display Trends – SQL Queries

Distribution of screen sizes in phones launched with 5G.

```sql
SELECT
    screen_size, COUNT(*) AS phone_count
FROM
    smartphones_cleaned_dataset
WHERE
    has_5g = 'True'
GROUP BY screen_size
ORDER BY screen_size;
```

Result Grid | Filter Rows

screen_size	phone_count
5.4	1
5.9	1
6	3
6.1	15
6.2	2
6.28	2
6.3	1
6.34	1
6.36	1

Most popular screen resolution for phones under ₹15,000.

```sql
SELECT
    CONCAT(resolution_width, 'x', resolution_height) AS screen_resolution,
    COUNT(*) AS count_resolution
FROM
    smartphones_cleaned_dataset
WHERE
    price < 15000
GROUP BY resolution_width , resolution_height
ORDER BY count_resolution DESC;
```

screen_resolution	count_resolution
720x1600	118
1080x2400	67
1080x2408	21
720x1612	12
1080x2340	11
720x1560	10
1080x2460	10
1080x2412	9
1600x720	6

Display Trends – SQL Queries

Which phones support 120Hz refresh rates, and what's their average price?

```sql
SELECT
  model,
  price
FROM smartphones_cleaned_dataset
WHERE refresh_rate = 120;
```

model	price
OnePlus 11 5G	54999
OnePlus Nord CE 2 Lite 5G	19989
Motorola Moto G62 5G	14999
Realme 10 Pro Plus	24999
Samsung Galaxy F23 5G (6GB RAM + 128GB)	16999
Xiaomi Redmi Note 12 Pro Plus	29999
Nothing Phone 1	26749
Realme 10 Pro	18999
Xiaomi Redmi Note 12 Pro 5G	24762

```sql
SELECT
    AVG(price) AS avg_price_120Hz
FROM
    smartphones_cleaned_dataset
WHERE
    refresh_rate = 120;
```

Result Grid

avg_price_120Hz
36024.9642

Display Trends

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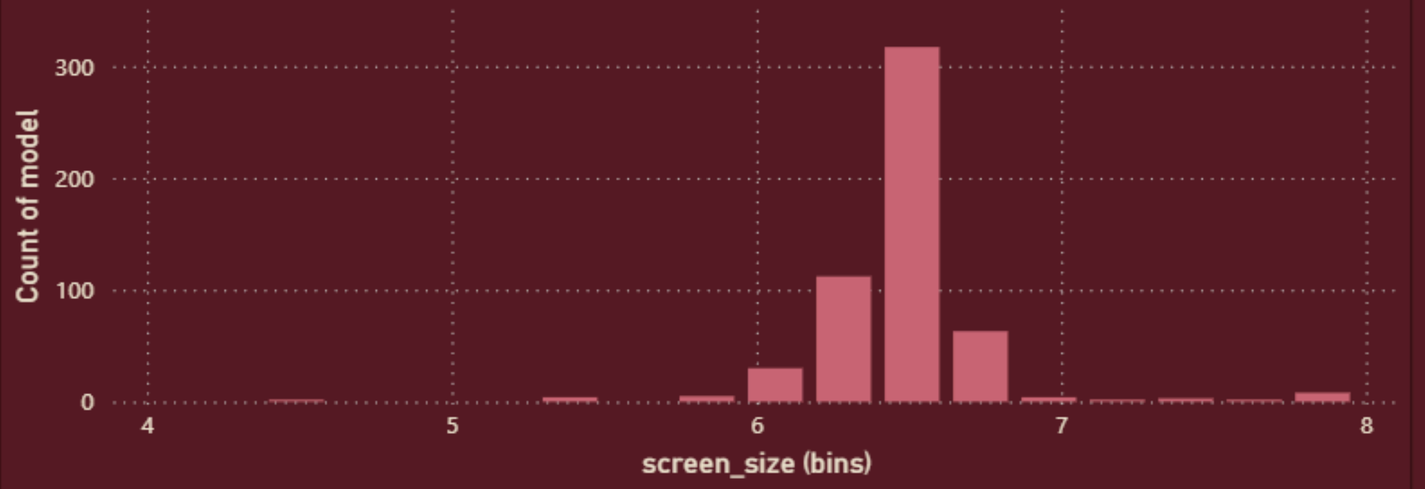
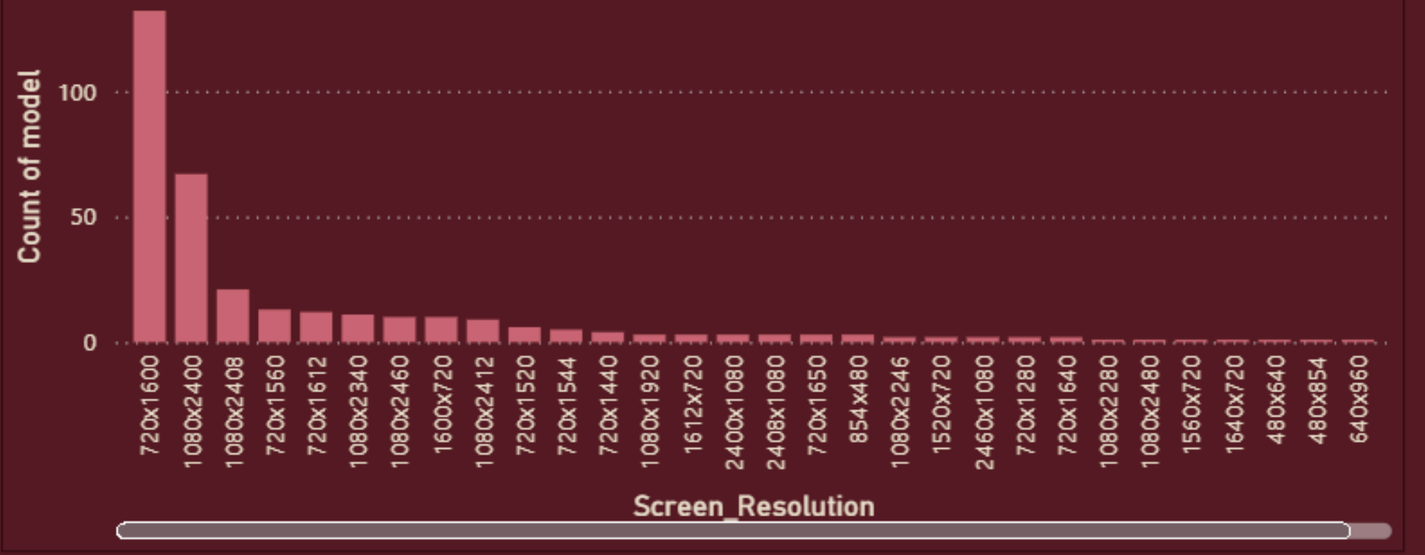
Distribution of screen sizes in phones with 5G



Most popular screen resolution for phones under ₹15,000.



Average price of phones support 120Hz refresh rates

46.00K

Phones support 120Hz refresh rates

model	price
Apple iPhone 13 Pro	119900
Apple iPhone 13 Pro (1TB)	147900
Apple iPhone 13 Pro (256GB)	129900
Apple iPhone 13 Pro Max	129900
Apple iPhone 13 Pro Max (1TB)	179900
Apple iPhone 13 Pro Max (256GB)	139900
Apple iPhone 14 Pro	119990
Apple iPhone 14 Pro (1TB)	172999
Apple iPhone 14 Pro (256GB)	129990
Apple iPhone 14 Pro Max	129990
Apple iPhone 14 Pro Max (1TB)	182999
Apple iPhone 14 Pro Max (256GB)	139990
Apple iPhone 14 Pro Max (512GB)	169900
Apple iPhone 15 Plus	84990
Apple iPhone 15 Pro	130990
Apple iPhone 15 Pro Max	142990
Apple iPhone 15 Ultra	149900

Comprehensive Smartphone Market Analysis & Consumer Insights

PRICE & RATINGS

- More RAM = Higher price. Phones with 12GB+ RAM are usually premium and expensive.
- Top processor brands (Bionic, Snapdragon) mean higher-priced phones, while others are more budget-friendly.
- Brands like Samsung, Oppo, Motorola, and IQOO give many options in lower price ranges.
- More internal memory and better ratings tend to cost more.

DISPLAY INSIGHTS

- Most 5G phones have screen sizes between 6 and 6.5 inches.
- The most popular screen resolution for budget phones is 720x1600.
- Phones with 120Hz screens are priced higher, usually above ₹40,000—mostly Apple iPhones.

BATTERY & PERFORMANCE

- Premium phones have the biggest batteries, but budget and mid-range options are improving and now offer good battery life.
- Doogee and Oukitel models are leaders for massive batteries and fast charging.
- Phones with Helio or Dimensity processors often come with larger batteries.

CAMERA TRENDS

- Models by Infinix, Vivo, and Tecno offer high-resolution front cameras (over 32MP) for under ₹25,000.
- Premium phones have much better rear cameras on average (up to 60MP).
- Honor, Infinix, and Motorola brands stand out for top rear camera megapixels.

CHOOSING THE RIGHT SMARTPHONE: INSIGHTS FROM MARKET DATA

The smartphone market today offers a wide variety of choices across price segments, catering to diverse customer needs. Performance, battery life, camera quality, and display features remain major decision drivers.

- **Performance & Pricing:** Phones with higher RAM and advanced processors like Apple's Bionic and Qualcomm Snapdragon generally come at premium prices beyond ₹50,000. Mid-tier models featuring Helio and Dimensity processors strike a balance between cost and capability, while budget phones offer good value through brands like Samsung, Motorola, and Oppo.
- **Battery & Charging**: Battery life is increasingly important across all segments. Premium phones usually pack the largest batteries, but mid-range and budget offerings are rapidly catching up with capacities often exceeding 6,000mAh. Brands specialized in rugged phones, such as Doogee and Oukitel, provide models with massive batteries and fast charging suitable for heavy users.
- **Camera Capabilities:** Photography remains a standout feature in premium and mid-range phones. Budget buyers can still access impressive front cameras from brands like Infinix and Vivo with over 32MP resolution. Rear cameras in premium devices can reach up to 200MP, offered by brands like Honor and Motorola, ensuring high-quality imaging.
- **Display and Connectivity Trends:** The majority of 5G phones feature screen sizes between 6 and 6.5 inches, with 720x1600 being the most popular resolution for budget devices. High refresh rate screens (120Hz and above) are mainly found in premium phones, indicating smoother viewing experiences come at a price point above ₹40,000.

CONSUMER RECOMMENDATIONS

- For performance-seekers and power users, devices with larger RAM and cutting-edge processors are ideal.
- Battery-conscious users should consider models with 6,000mAh+ capacity and fast charging, often found in Helio or Dimensity powered phones or rugged device makers.
- Photography enthusiasts find value in premium and mid-range phones from brands excelling in camera technology, especially rear cameras for detailed images or high-res front cameras for selfies.

This comprehensive analysis equips customers to make informed purchase decisions tailored to their usage priorities—whether it’s power, camera, battery life, or budget.

THANK YOU

GITHUB- https://github.com/tanishirai/Smartphone-Analysis